On some intrinsic and environmental factors controlling the distribution of dragonflies (Odonata), with redescription and a new name for a little known species

by

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Every collector and every systematist must have wondered at some time or other why one species in the group which he is collecting or studying is common, and other species, close in every respect to the first, are extremely rare, although belonging perhaps to the same genus and distinguishable from the common species only by minor, or even microscopic details.

In this paper I propose to present some data relating to this subject. By definition a rare species is one, of which representatives are encountered very infrequently, seldom captured, and only occasionally found in collections. And yet there can be no doubt that a species which occurs in nature in very small numbers cannot survive, as males and females would not be able to find one another for breeding. There is a minimal size beneath which an effectively breeding population cannot sink without being in danger of extinction. In other words, a rare species cannot be rare everywhere, but must be common enough in some special localities, unless we are dealing with a species in the last stages of extinction. A rare species is thus a species occurring only in very restricted habitats, and a common species is one which is found in a variety of localities or under conditions which are prevalent over large areas of the country.

The question of why one species is common and a closely related species is rare may thus be substituted by a question about the special conditions that are required by rare species, and the type of conditions which satisfy the more common species.

I will now illustrate this statement by considering some closely related species of dragonflies, of which some are common, and some are rare.

Figure 1 shows the distribution of *Enallagma glaucum* (Burm.) which is a very common species in South Africa. The black squares on the map represent the actual records from the literature (mainly Ris, 1921; Barnard, 1937; Pinhey, 1951 and Brinck, 1955), and from my own collection. These records comprise almost all the available data as the specimens in the South African Museum are listed by Barnard, and the specimens in the Transvaal Museum are in part included in Pinhey's book; I have not checked on the museum specimens, however.

It may be seen from the map that *E. glaucum* is widespread over most of the area. It is absent apparently from Northern Bechuanaland and from the Natal coast. I have visited the latter area repeatedly and have never found it there.

Figure 2 shows the distribution of some of the less common and the rare species of the same genus. *E. nigridorsum* Selys, a species closely resembling the previous one, inhabits the coastal region of Northern Natal and is found also further north in Rhodesia and Eastern Africa. In Natal *E. nigridorsum* and *E. glaucum* occur as alternative species, but their distribution overlaps in Rhodesia.

Enallagma sapphirina Pinhey appears to have an extremely restricted area of distribution in the central Transvaal, where it occurs side by side in the same localities (in the same streams and dams) as *E. glaucum*. A record of *E. sapphirina* from Zululand (Pinhey, 1951) probably needs confirmation.

Two further species have been found only in restricted localities: *E. polychromaticum* Barnard in mountainous parts of the Western Cape and *E. moremi* (see Appendix 1) in Northern Bechuanaland (another record of the latter species is from Angola).

Figure 3 shows the distribution in Southern Africa of two further species of *Enallagma: elongatum* (Martin) and *subfurcatum* Selys, both occur in Eastern Africa also. In Southern Africa they have a markedly discontinuous distribution. *E. elongatum* has been recorded from Salisbury (Pinhey, 1951) and further northwards, but I collected a few specimens along a stream in the Montrose Falls area. It is fairly certain that the species is not represented in the intervening zone (stretching over some 500 miles) or, if present, is extremely rare. A still more peculiar distribution is shown by *E. subfurcatum* which is found in the northern and eastern parts of Rhodesia, but one specimen of this species was collected by P. Brinck on the Cape Flats! (Brinck, 1955).

Discontinuous distribution such as in the latter case presents a difficult problem. It is hardly possible that a species like *E. subfurcatum* exists in the Cape Flats in the form of a permanent colony so small that it has escaped the notice of workers in Cape Town. One would rather suspect that chance migration, perhaps supported by winds, is responsible for Brinck's record.

Figure 4 by contrast, shows the distribution of a very common and extremely widespread species closely related to *Enallagma*, namely of *Ischnura senegalensis* (Ramb.). The records of *I. senegalensis* may almost be taken to indicate the coverage of Southern Africa by dragonfly collection, as there are very few localities in which dragonflies have been collected and where *I. senegalensis* has not been found.

Numerous cases may be quoted to show that an animal is considered to be extremely rare until the locality is found where the species is sufficiently numerous to ensure its continued existence. I will quote two examples from my own experience with dragonflies.

In 1955 I collected a specimen of *Olpogastra lugubris* (Karsch) on the bank of the Limpopo river at the point of its confluence with the Pafuri. This was the first and only specimen of the species ever taken within the limits of the Republic of South Africa. I did not see it again until I went to the Okavango

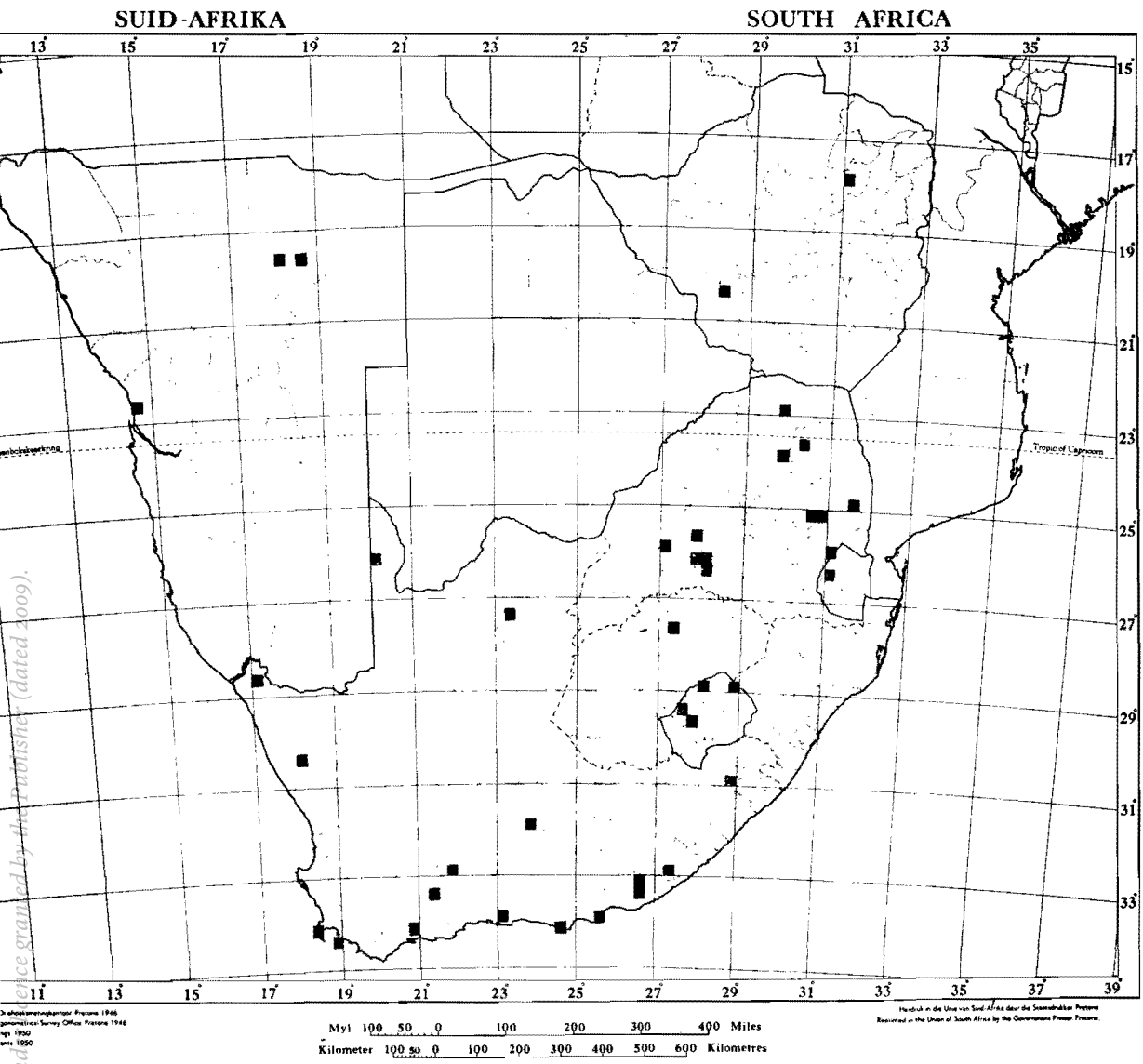

Fig. 1. Distribution in Southern Africa of *Enallagma glaucum* (Burm.)

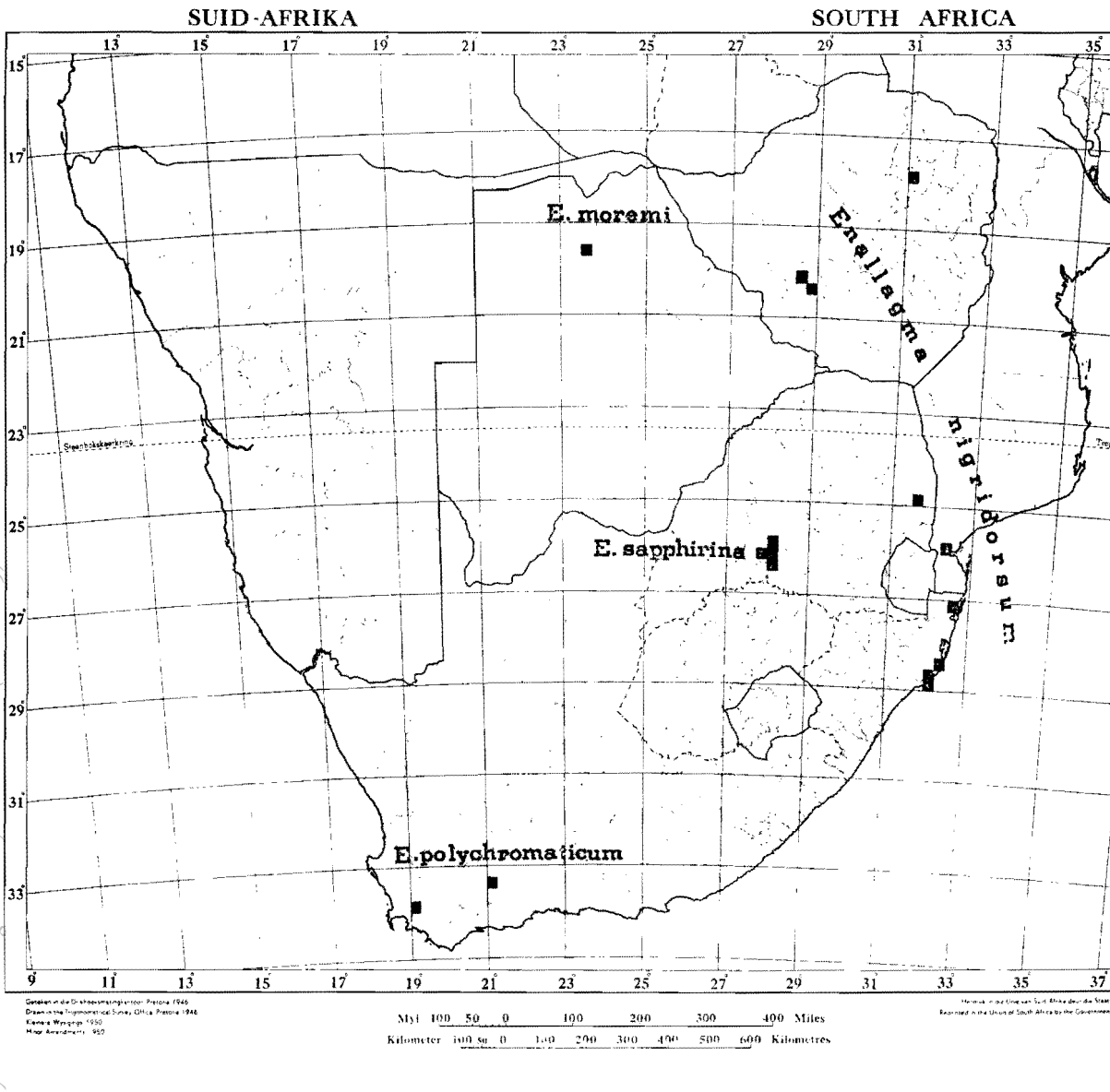

Fig. 2. Distribution in Southern Africa of *Enallagma nigridorsum* Selys, *E. sapphirina* Pinhey, *E. polychromaticum* Barnard and *E. moremi* Balinsky.

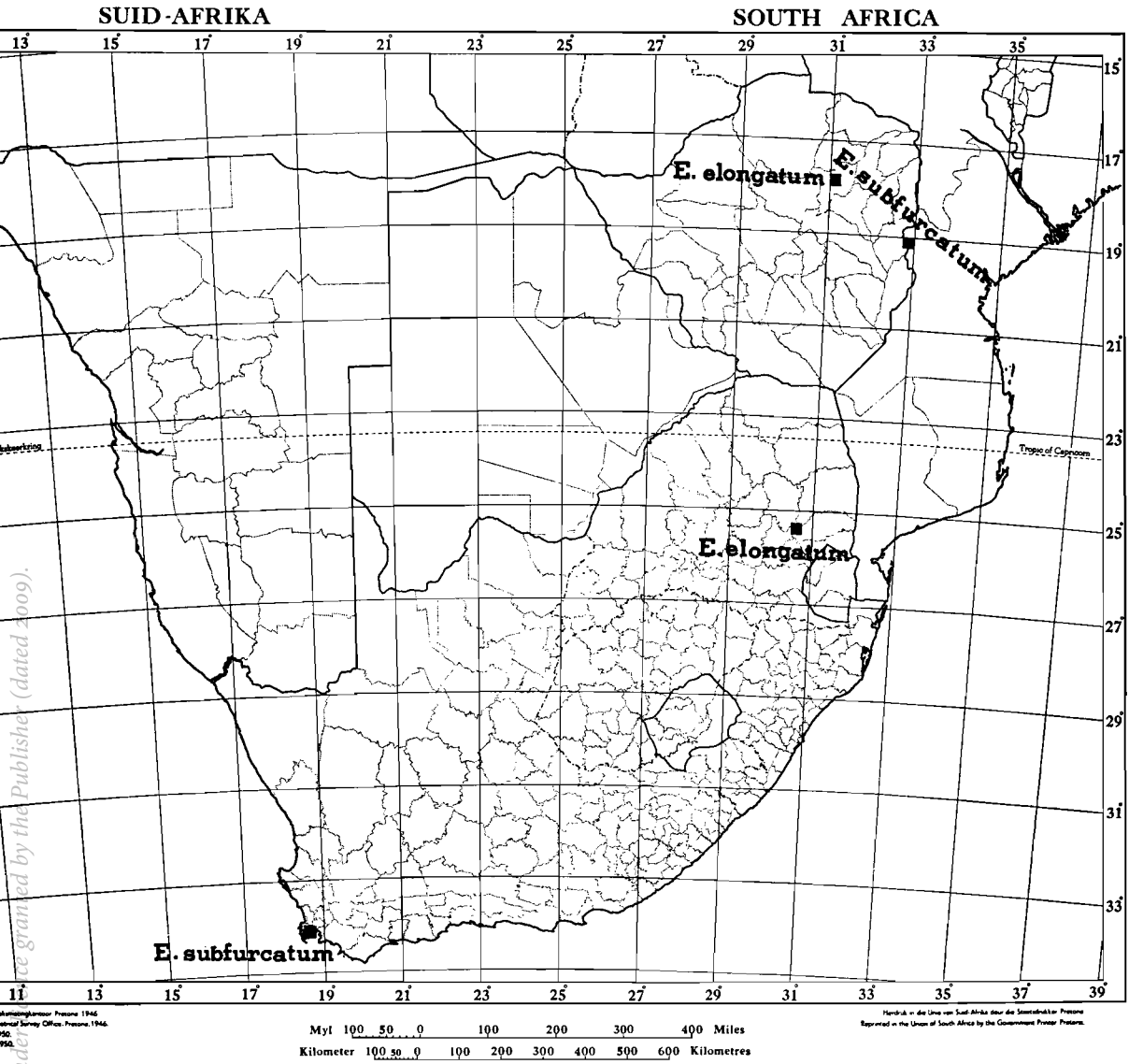

Fig. 3. Distribution in Southern Africa of *Enallagma elongatum* (Martin) and *E. subfurcatum* Selys.

Swamp and there, on the Kwaai River, *O. lugubris* was flying in such numbers along the stream that several specimens could be seen at the same time. The species is reported by Pinhey (1951, 1961) as fairly abundant from Zambesi northwards and in East Africa. Obviously the specimen on the Limpopo was at the margin of the area of distribution of the species.

Another somewhat similar case is presented by a species of *Orthetrum*. In 1959 at Richards Bay I captured a specimen of *Orthetrum* which did not seem to fit into the known species of the genus. In two subsequent collecting trips to the same area I did not find any specimens to match the first one in spite of careful search. Again an expedition to the Okavango Swamp, particularly to the Moremi Game Reserve, solved the problem. I collected a series of specimens which were obviously conspecific with the specimen from Richards Bay. They proved to represent an undescribed species (see Balinsky, 1965). Again the single specimen at Richards Bay must have been outside the normal area of distribution of the species.

In both cases it is not easy to tell why the species remains restricted to a particular area, although it is well within its abilities to reach from Northern Bechuanaland into Natal. The explanation for a third rare find which I made in recent years is easier. On a visit to the Kosi Bay area I found, flying on the shores of the lagoon, fairly large red dragonflies which at first I thought to be *Urothemis assignata* (Selys). I succeeded in catching two specimens, and on closer inspection saw that they were completely unknown to me. They turned out to be specimens of *Macrodiplax cora* Brauer, which had never before been seen on the African Continent; this is an Indo-Pacific species, widely distributed on the islands of the Pacific and Indian Oceans and coastal regions of South-Eastern Asia (Pinhey, 1962). It has been recorded from Socotra, Mauritius and, possibly, Madagascar. The habits of this dragonfly are reported as follows: "A littoral and wind-borne species, breeding chiefly in oligohaline waters and having great dispersal facilities, ... only occasionally found inland" (Lieftinck, 1954) "A well-known migratory species, chiefly insular and coastal. It is salt-tolerant, preferring open country and breeding freely in lagoons and estuaries of rivers" (Lieftinck, 1962). Kosi Bay with an increasing gradient of salinity towards the mouth (see Broekhuysen and Taylor, 1959) provides exactly the kind of habitat preferred by *M. cora*, and it is therefore quite likely that the dragonflies which I have seen (there were many more than the two I succeeded in catching) were not just occasional migrants brought in by a favourable wind, but that the species might be breeding in the Kosi Bay Estuary.

In *M. cora* we have a species which, though widespread geographically, appears to be tied down to a very specific kind of environment.

Generally common species should be less demanding in respect of environment, or broadly adaptable, thus able to make use of environments which are not acceptable to other more fastidious or specialized species. Artificial waters (dams, large and small) may be considered as tests for adaptability of aquatic organisms in general and dragonflies in particular. It is my impression that on dams the variety of dragonflies is poorer and more restricted than on natural waters. To verify this impression I have chosen for comparison some dams

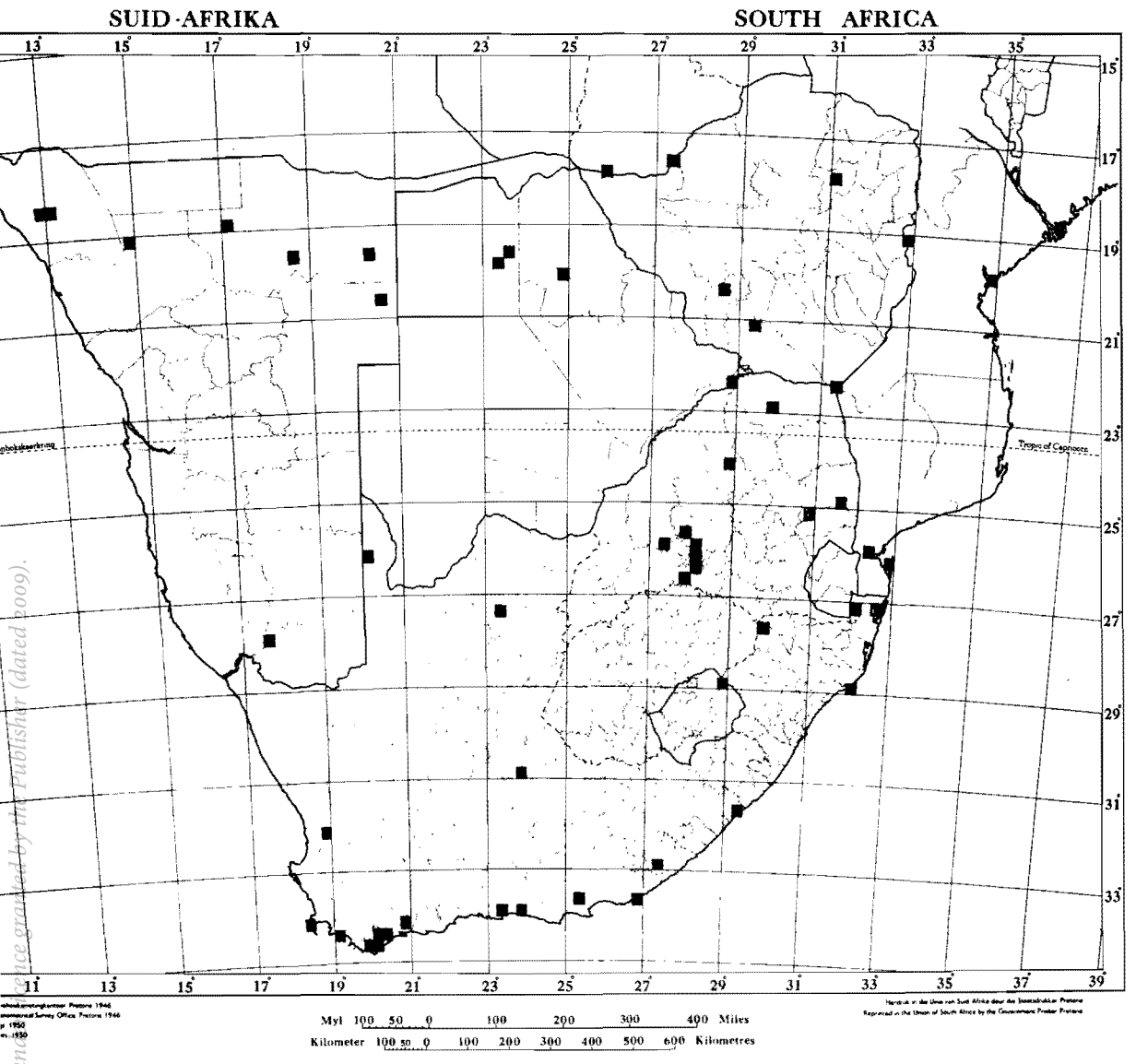

Fig. 4. Distribution in Southern Africa of *Ischnura senegalensis* (Ramb.)

from which I believe I have made fairly representative collections of dragonflies, and some roughly corresponding natural habitats.

Dams.		Natural habitats.
Buffelspoort Dam (Magaliesberg)	—	River at Swartkop, between Johannesburg and Pretoria.
Happy Rest Dam (at foot of Zoutpansberg)	—	Magalakwin — Limpopo, N.W. Transvaal.
McIlwain Lake, Salisbury	—	Okavango swamp, specifically the swamp in and adjoining the Moremi Game Reserve.

TABLE 1.

Species common to both localities

	No. of sp.	Happy Rest Dam	Lake McIlwain	Buffelspoort Dam	Swartkop	Magalakwin-Limpopo	Okavango Swamps	Kariba before flooding	Kariba during flooding	Kariba present
Happy Rest Dam	8		4	6	3	5	2	5	5	5
Lake McIlwain	10	44		6	4	6	4	6	5	6
Buffelspoort Dam	11	63	57		5	7	4	8	7	9
Swartkop	25	18	23	28		11	2	4	4	4
Magalakwin-Limpopo	27	29	32	37	42		4	17	9	12
Okavango Swamps	27	11	22	21	8	7		6	7	8
Kariba before flooding	32	25	29	37	14	58	20		15	17
Kariba during flooding	22	33	31	42	17	37	29	56		18
Kariba present	24	31	29	51	16	47	27	61	78	

Percentage of "affinity"

I have also included the dragonfly fauna of the Kariba Lake area. For reasons which will be evident later, the dragonflies recorded on the Kariba Lake are subdivided in three groups: a) those that were present at the beginning of the flooding of the lake and also on the rivers and streams outside the flooded area; b) those that were found on the lake whilst the waters of the lake were rising; c) those that are to be found there at present, after the level of the water in the lake has stabilized.

To estimate the degree of affinity of the faunae in different localities I have calculated the ratio of the number of species common to any two localities to the total number of species in both localities together. So in the case of Happy Rest Dam and the McIlwain Lake, for instance, the number of species at Happy Rest Dam found also at McIlwain Lake is four; the number of species at Happy Rest Dam not found at McIlwain Lake is likewise four. Of 10 species collected at McIlwain Lake four species occur at Happy Rest Dam, six species were not collected at Happy Rest Dam. The degree of affinity is then:

$$\frac{4 + 4}{8 + 10} = \frac{8}{18} = 44\%$$

Table 1 shows the affinities of populations of different localities in all possible combinations. (For a full list of species recorded see Appendix 2.)

Analyzing the data presented in Table 1 (exclusive for the time being of the data referring to Kariba Lake after flooding) we find that:

a. Affinity in artificial bodies of water (dams) among themselves is (in %) 44, 57, 63 — comparatively rather high.

b. Affinity between artificial bodies of water and natural habitats is (in %) 11, 18, 21, 22, 23, 25, 28, 29, 29, 32, 37, 37. The figures are in general decidedly lower than in the first group, and show a very much greater scatter.

c. Affinity between different natural localities is (in %) 7, 8, 14, 20, 42, 58.

These last figures are in striking contrast with the data obtained from artificial bodies of water and show, as may be expected that the faunae of natural habitats are not only richer by far (as reflected in the number of species) than the faunae of artificial bodies of water, but that they are also much more diversified, whilst in artificial bodies of water the same species are encountered again and again.

The same conclusion may be reached if, instead of considering numbers of species common to two or more localities, we consider the species found only in one of the localities but in none of the others. I will refer to such species as "pseudoendemics" for all the species under consideration have been recorded from localities other than the ones used in the present analysis, and some are actually widespread.

The numbers of species found only in *one* of the named localities ("Pseudo-endemics") are:

Happy Rest Dam	1	Artificial bodies of water
McIlwain Lake	0	
Buffelpoort Dam	0	
Swartkop	10	Natural bodies of water
Magalakwin-Limpopo	3	
Okavango	16	
Kariba area	10	

The only recorded "pseudoendemic" species in artificial bodies of water is *Enallagma glaucum*, which is a common and widespread species, but happens to be absent in all the other localities which I have chosen for consideration.

All the localities with natural habitats have at least some "pseudo-endemic" species. These are what we would call the "rare" species. The number of "pseudoendemic" species of the Magalakwin-Limpopo would be higher but for the fact that some of the more "rare" species found there also occur in the Kariba area.

The general conclusion so far is that when an artificial body of water is created, only a limited number of species of dragonflies invade the new biotope and these species are much the same in areas as far apart as Magaliesberg (Buffelspoort Dam) and Salisbury (McIlwain Lake). The species that have been found in all three of the dams which I have studied are: *Ischnura senegalensis* (Ramb.), *Orthetrum trinacria* Selys, *Brachythemis leucosticta* (Burm.) and *Trithemis annulata* (Beauv.).

All these species are widely distributed in natural biotopes and are presumably not specially adapted for artificial lakes and dams only, but these four species (and others to a lesser extent) have been able to spread into the newly created biotopes more easily than others.

Artificial dams take the place of a section of a stream or river. If as I have shown, the dragonfly fauna of a dam is poorer and more uniform than that of a river (compare Swartkop and Magalakwin); it follows that some of the typically riverine species are exterminated, or ousted by the formation of a dam.

The process of replacement of some species by others can probably be observed on any hydrotechnical project. I will report some results of my own observations on a project of enormous dimensions, namely on the Kariba Lake.

I began observations on the Kariba Lake in September 1959, when the flooding of the valley was still in the initial stages, and many streams and rivers, which are now submerged under 100 feet of water were in their original condition. Some streams in the vicinity of the lake which are outside the flooded area may also be used to complete the list of species which belong to the original fauna of the area now taken up by the lake.

Compiled in this way, the original fauna of the area consisted of at least 30 species of which 10 were "pseudoendemics".

During the years 1960—1963 several visits to the Kariba Lake were made and 22 species of dragonflies collected of which six are "pseudoendemics". The lake in the meantime reached its highest level.

Two further collecting trips made in 1964 and 1965 may be considered as giving indication of the present fauna of dragonflies on the lake; 24 species were collected with six "pseudoendemics" (some, but not all, the same as in 1960-1963).

The figures show a decrease in the number of species on the lake as compared with the original fauna, as well as a decrease of the number of "pseudoendemics". The latter decrease is even greater than would appear from the figures, as not the same "pseudoendemic" species were found in different years. Of the original 10 "pseudoendemic" species, eight are not found on the lake at present. The species are: *Ceriagrion suave* Ris, *Pseudagrion whellani* Pinhey, *Aciagrion attenuatum* Fraser, *Tetrathemis polleni* (Selys), *Orthetrum brachiale* (Beauv.), *Palpopleura lucia* (Drury), *Trithemis basitincta* Ris, *Urothemis edwardsi* Selys. In addition to these, six other species which do not fall under the category of "pseudoendemics", have disappeared or at least have not been found at the lake at present: *Lestes pinheyi* Fraser, *Metacnemis singularis* (Karsch), *Pseudagrion acaciae* Förster, *Pseudagrion pseudomassaicum* Pinhey, *Paragomphus hageni* (Selys) and *Phyllomacromia picta* Selys. In all, 14 species from the original fauna of the area are not longer to be found on the lake. Some of these 14 species are distinctly rare ones — seldom seen or restricted in their distribution. Nine other species not recorded originally have been collected on the lake after flooding. The species are: *Elattoneura fraenulata* (Hagen), *Pseudagrion nubicum* Selys, *Agriocnemis exilis* Selys, *Phyllomacromia reginae* le Roi, *Orthetrum stemmale kalai* Longf., *Nesciothemis farinosum* (Förster), *Acisoma panorpoides ascalaphoides* Ramb., *Rhyothemis semihyalina* (Desj.) and *Tholymis tillagra* (Fabr.). All these species are widespread and fairly common ones. Of course my records are of the nature of samples taken during visits restricted in time and limited to small parts of the lake circumference. Many species may have been overlooked. Nevertheless it is my opinion that some change has occurred, even if the change consists in that some species do not disappear altogether, but become less frequent. The trend is towards a reduction in numbers of species and to a replacement of rarer species by common ones.

If the affinities of the Kariba fauna of dragonflies to the faunae of other localities are worked out for different periods in the flooding of the lake results are obtained as shown in Table 2.

TABLE 2.

Affinity (in %)	To natural bodies of water	To artificial bodies of water
Zambesi valley before flooding	14, 20, 58	25, 29, 37
Kariba Lake after flooding	17, 29, 37	31, 33, 42
Kariba at present	16, 27, 47	29, 31, 51

The affinity to the fauna of natural bodies of water does not show any distinct trend, whilst the affinity to the fauna of artificial bodies of water has undoubtedly increased.

The impoverishment of the dragonfly fauna on the Kariba Lake has not gone as far as in the smaller dams which I have mentioned before. The reason is obviously due to the enormous size of the lake and the great variety of natural conditions, ranging from open waters in the middle of the lake to secluded bays and swamps on its edges.

It would not be astonishing if some of the biotopes in this variety of environmental conditions could provide for peculiar communities of animals and plants, not occurring elsewhere in our faunal region. Such a community would have its own assortment of dragonflies. It is well known (see Balinsky and James, 1960; Boughey, 1963) that soon after its filling the Kariba Lake became the site of extensive growth of the water fern Salvinia auriculata, which virtually choked the more secluded parts of the lake and formed floating islands even on open parts of the lake — the "sud"; in this connection I want to mention the appearance of *Pseudagrion nubicum* Selys. This species was not found in the Kariba area in 1959 nor in 1960. As the collecting on both occasions was done very thoroughly and as *P. nubicum* is a very conspicuous bright dragonfly, easily distinguishable from other *Pseudagrion* species present on the lake, I am fairly sure that it was actually absent from the area in which the collecting was done, and not just overlooked. *P. nubicum* was first collected on the lake in December 1961, when the development of the sud on the lake was at its peak. One specimen was actually taken freshly emerged from a nymph on the Salvinia sud. Another specimen was taken on a sud island 1½ miles out from the shore in July 1962. This dragonfly is not a newcomer in Rhodesia in general, and occurs in small numbers on the Zambesi at the Victoria Falls. Nevertheless the impression is inescapable that the advent of *P. nubicum* to the Kariba lake was somehow connected with the development of the Salvinia sud. After 1962 the further growth of Salvinia on the lake slowed down and at present masses of it remain only in the sheltered bays of the lake. P. *nubicum* which accompanied Salvinia in the invasion of the lake, has in the meantime become firmly established, and on my last visit I found the species quite abundant. In this way it would seem that a freak change in environment has transformed a rare species of dragonfly into a common one.

Appendix 1

Redescription and a new name for a little known species of Enallagma Charpentier.

A series of small dragonflies collected in the Moremi Game Reserve, Bechuanaland turned out to be identical with the species described originally by Ris (1931) as *Enallagma minutum*. As indicated by Pinhey (1962) the name is preoccupied by *E. (Trichocnemis) minuta* Selys, 1857.

Pinhey (l.c.) proposed to name the species *E. risi* nom. nov. However, the latter name is also preoccupied by *Enallagma risi* Schmidt (1961), given to a species from Central Asia. It is therefore necessary to give the species a new name, and I propose to name it *Enallagma moremi* nom. nov.

As Ris described his species from one not very well preserved male, and as the species has apparently not been observed or examined since, it seems appropriate to note a few features of the species, as represented by specimens in my possession.

Enallagma moremi nom. nov.

Synonyms: **E. minutum** Ris, 1931, nec *E. (Trichocnemis) minuta* (Selys) 1857; **E. risi** Pinhey, 1962, nec *E. risi* Schmidt, 1961.

The species resembles in size and habitus representatives of the genus *Agriocnemis*; however, the wing venation and the structure of the male genital appendages clearly place the species in the genus *Enallagma*. Females are polychromatic.

Male with fully developed colours. Labium pale yellow; labrum bright yellow along the lower edge but black in upper half; anteclypeus and genae bright yellow; postclypeus, frons, vertex and occiput black with green metallic sheen. Ris (l.c.) described the light coloured parts of the face as "trüb blau" — this is obviously the result of poor preservation ("mittelmässig erhalten") of the specimen which he had at his disposal. Eyes greenish-yellow, black on top; postocular spots transversely elongated and curved backwards, blue. Posterior surface of head black with a pale blue transverse line above the neck and large pear shaped yellow spots behind the eyes.

Prothorax with broad yellow lateral margins and a yellow transverse stripe anteriorly. At anterior end of synthorax a pair of projecting black lobes, as described by Ris; synthorax black with a green sheen above and dorsolaterally down to first humeral suture, which the black area surpasses slightly at posterior end, with narrow straight bluish-green ("blaulich" according to Ris) antehumeral stripes which broaden slightly anteriorly and do not quite reach the posterior end of the mesepisternum. The sides of the synthorax bluish-green with a black spot at upper end of second lateral suture. Wings (including venation) and legs as described by Ris. The red colour of the pterostigma is very conspicuous. The first abdominal segment black with blue sides (this differs from the description by Ris). Segments 2-8 black dorsally with some blue laterally on

distal ends of segments 2 and 8, otherwise yellow ventrolaterally; 9 blue, 10 black; edge of segment 10 not raised. Anal appendages as described and figured

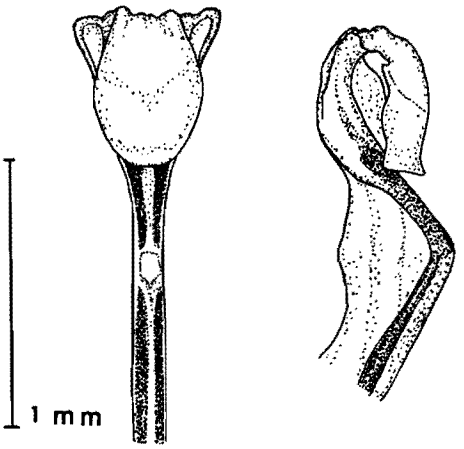

Fig. 5. *Enallagma moremi* nom. nov., penis in ventral and lateral view.

by Ris. The "head" of the penis with very distinct auricles at posterior angles, with the free edge evenly rounded as seen from the ventral side, but with angular lateral projections before the free end, seen in lateral view (see Fig. 5).

FEMALE homoeochromatic (andromorphous): Very like the male but the yellow colour on the face somewhat paler. Posterior lobe of prothorax not raised, semicircular in general outline, but with posterior edge straight medially. There are no protruding lobes on the synthorax. Mesostigmal laminae bearing a swelling with a finely serrated edge laterally; the swelling is yellow, and this colour extends along posterior edge of the lamina half way to its dorsal end. The red of the pterostigma is not as bright as in the male. The colours on the abdomen are similar to those in the male, but there is on the dorsal side of segment 9 a transverse biconvex black spot proximally and some blue on the sides of segment 10.

FEMALE heterochromatic: Anteclypeus and part of the genae pale yellow, otherwise the whole head (excluding eyes) reddish-brown, with faint blue diffuse postocular spots. Thorax entirely reddish-brown without black markings. Black markings on the abdomen similar to those in homoeochromatic female, but the blue is replaced by reddish-brown; only segment 9 shows a tinge of blue.

	Abdomen	*Hind wing*	*Postnodal cross veins*		
♂♂	17, 19 mm	10.5-11 mm	8½-8½		8½-8
♀♀	17, 18 mm	11-12½ mm	10/8-8½	8½-8½	8½-9½

Four ♂♂, one homoeochromatic ♀ and eight heterochromatic ♀♀ collected in Moremi Game Reserve, Bechuanaland on 1.I.1964. One male and one female will be deposited in the Transvaal Museum.

Appendix 2

Records used for comparing faunae of different localities.

Dragonflies of the family Aeshnidae are not included in this survey, as collections from the various localities are not sufficiently representative. The nomenclature is that of Pinhey (1929).

Species	Happy Rest Dam (Zoutpansberg)	Lake McIlwain (Salisbury)	Buffelspoort Dam (Magaliesberg)	Swartkop	Magalakwin-Limpopo	Okavango Swamps	Kariba		
							Kariba before flooding	Kariba during flooding	Kariba Lake at present
Lestes plagiatus (Burm.)		+	+	+					
L. pinheyi Fraser						+	+		
L. wahlbergi Ris						+			
Elattoneura frenulata (Hagen)								+	
E. glauca (Selys)				+	+				
Metacnemis singularis (Karsch)					+		+		
Ceriagrion corallinum Campion(?)							+	+	+
C. glabrum (Burm.)		+				+	+	+	+
C. suave Ris							+		
C. katomborae Pinhey						+			
Pseudagrion acaciae Foerster					+		+		
P. assegai Pinhey						+			
P. deningi Pinhey						+			
P. helenae Balinsky						+			
P. kersteni (Gerst.)		+		+					

Species	Happy Rest Dam (Zoutpansberg)	Lake McIlwain (Salisbury)	Buffelspoort Dam (Magaliesberg)	Swartkop	Magalakwin-Limpopo	Okavango Swamps	Kariba		
							Kariba before flooding	Kariba during flooding	Kariba Lake at present
P. massaicum Sjoestedt		+		+	+	+			
P. natalense Ris				+					
P. nigerrimum Pinhey					+		+	+	+
P. nubicum Selys								+	+
P. pseudomassaicum Pinhey					+		+		
P. rubroviridis Pinhey					+		+	+	+
P. salisburyense Ris	+			+	+				
P. whellani Pinhey							+		
Aciagrion attenuatum Fraser							+		
A. steeleae Kimmins						+			
Enallagma glaucum (Burm.)	+								
E. moremi nom. nov.						+			
Ischnura senegalense Rambur	+	+	+		+	+	+	+	+
Agriocnemis exilis Selys						+		+	+
Phaon iridipennis (Burm.)					+				
Platycypha caligata (Selys)				+	+				
Ictinogomphus ferox (Ramb.)					+		+		+
Notogomphus praetorius (Selys)				+					
Ceratogomphus pictus (Hagen)	+		+	+					

Species	Happy Rest Dam (Zoutpansberg)	Lake McIlwain (Salisbury)	Buffelspoort Dam (Magaliesberg)	Swartkop	Magalakwin-Limpopo	Okavango Swamps	Kariba		
							Kariba before flooding	Kariba during flooding	Kariba Lake at present
Paragomphus cognatus (Ramb.)				+					
P. hageni (Selys)					+		+		
Onychogomphus supinus (Hagen)				+					
Macromia picta (Hagen)				+	+		+		
M. reginae le Roi						+		+	+
Tetrathemis polleni (Selys)							+		
Orthetrum abbotti Calvert				+					
O. brachiale (Beauv.)							+		
O. caffrum (Burm.)				+					
O. chrysostigma (Burm.)	+		+	+	+		+	+	+
O. falsum Longfield				+					
O. icteromelas Ris						+			
O. machadoi Longfield						+			
O. robustum Balinsky						+			
O. stemmale Kalai Longfield									+
O. trinacria (Selys)	+	+	+				+	+	+
Nesciothemis farinosum (Foerst.)			+	+	+	+			+
Palpopleura deceptor (Calvert)							+		+
P. jucunda Rambur		+		+	+				
P. lucia (Drury)							+	+	

Species	Happy Rest Dam (Zoutpansberg)	Lake McIlwain (Salisbury)	Buffelspoort Dam (Magaliesberg)	Swartkop	Magalakwin-Limpopo	Okavango Swamps	Kariba		
							Kariba before flooding	Kariba during flooding	Kariba Lake at present
Hemistigma albipuncta (Rambur)						+			
Acisoma panorpoides ascalaphoides Rambur						+		+	+
Diplacodes exilis Ris(?)						+			
D. lefebvrei (Rambur)			+			+	+	+	+
Crocothemis erythraea (Brullé)		+	+		+		+		+
C. sanguinolenta (Burm.)				+					
Brachythemis lacustris (Kirby)					+		+	+	+
B. leucosticta (Burm.)	+	+	+		+	+	+	+	+
Philonomon luminans (Karsch)						+			
Trithemis annulata (Beauv.)	+	+	+		+		+	+	+
T. arteriosa (Burm.)			+	+	+		+	+	+
T. basitincta Ris							+		
T. donaldsoni (Calvert)					+		+		
T. dorsalis (Rambur)				+					
T. ellenbecki Foerster (= *T. risi* Longfield)				+					
T. hecate Ris						+			
T. kirbyi ardens Gerstaecker				+	+		+	+	+
T. monardi Ris						+			
T. stictica (Burm.)						+			

Species	Happy Rest Dam (Zoutpansberg)	Lake McIlwain (Salisbury)	Buffelspoort Dam (Magaliesberg)	Swartkop	Magalakwin-Limpopo	Okavango Swamps	Kariba		
							Kariba before flooding	Kariba during flooding	Kariba Lake at present
T. werneri Ris					+				
Zygonyx torrida (Kirby)				+	+				
Olpogastra fuelleborni Gruenberg					+				
Rhyothemis semihyalina (Desj.)									+
Tholymis tillarga (Fabr.)								+	
Pantala flavescens (Fabr.)				+				+	
Urothemis assignata (Selys)							+	+	+
U. edwardsi (Selys)						+	+		

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